Remarks

Claims 1-14 are pending in the application. Claims 1-8, 10-13 are rejected. Claims 9 and 14 are objected to and allowable if rewritten to overcome the objection. Claim 15 is new. No new subject matter is added.

The Examiner objected to the drawings. Figures 3A and 3B have been amended to include reference numeral 21, as described at page 8. A drawing amendment is filed herewith, with an Annotated Marked-up Drawing, and Replacement sheet.

The Examiner objected to claims 1, 9, and 14. Claim 1 has been amended to define the similarity score. Claim 9 has been amended to define a function of weights, a number *N* of extracted features, and distances *D*. Claim 14 has been amended to reference a function *S*(*T*, *R*).

The Examiner rejected claims 1-6, and 7-8 as being unpatentable over Lin et al., (U.S. 6,763,127 - 'Lin') in view of Riganati (U.S. 4,135,147 - 'Riganati').

Lin describes a method for recognizing fingerprints. Lin constructs a directional map of 8x8 bit blocks of an image. Each block has a location and direction. It should be noted that the Lin '*blocks of bits*' that have locations and directions are **not** the features he uses for fingerprint matching. Features only come later, after morphological filtering, thinning, and numerous other steps. Lin extracts ridge flows and minutia. At this point features have been extracted, see column 2

> After feature extraction is accomplished, a feature file having a size of approximately 400 bytes is generated and stored in a database. This feature file represents one fingerprint.

Nowhere, does Lin describe that the 400 byte record includes a location and orientation of each extracted feature. The only thing that has location and direction are the 8x8 bit blocks. But it is quite clear from Lin that the blocks are not the weighted features as claimed. The Applicant respectfully directs the Examiner to read column 1 line 55 to column 2, line 21.

2. Dynamic thresholding. In step **101**, For each 8 bit×8 bit block of image, an average intensity value is calculated by simple addition of the intensity values then divided by sixty four, the number of bits in an 8×8 bit block. If the intensity value of a pixel in this 8 bit×8 bit block is above the average calculated intensity value its binary value is assigned to zero. Otherwise, its binary value is assigned to one.
3. Ridge flow extraction. At step **102**, eight sets of 16×1 directional filters are applied to each 8×8 block. A directional code is assigned to this block based on the filter response. For an N×N image, an N/8×N/8 directional map

4. Directional morphological filtering. In step **103**, a series of morphological filtering is applied to link the broken ridges and to break falsely connected ridges that may be caused by moisture.
5. Thinning. In step **104**, thinning is performed.
6. Minutia detection. In step **105**, minutia detection is performed.
7. False minutia removal. In step **106**, false minutia removal is performed.
   a) Pore removal by ridge tracing. Ridges are traced to locate and delete pores.
   b) Fork point retrieval. If several end minutia points are in close region and if there is no ridge in between the points and their orientations satisfy defined conditions, then these end points are merged into a fork minutia point.

After feature extraction is accomplished, a feature file having a size of approximately 400 bytes is generated and stored in a database. This feature file represents one fingerprint.

Lin does not measure differences of location and orientation of his features. It is unclear what the Examiner thinks the features are. At one point, the Examiner cites features at column 1, lines 63-67 having location and orientation.

directional filters are applied to each 8×8 block. A directional code is assigned to this block based on the filter response. For an N×N image, an N/8×N/8 directional map is generated.

So it is presumed that the Examiner means the 8x8 blocks of bits to be the feature for the purpose of the rejection. Yet, in the next sentence, the weights are determined for 'minutia' points.

applied to the recognition process. A gaussian-distributed weighting function is applied to each minutia point in the reference image.

The Applicant is confused. First the Examiner implies that 8x8 bit blocks are features, and then the examiner implies that minutia extracted from ridge flows, which are extracted form blocks are the features. These statements are in direct conflict. Clarification is respectfully requested, or the rejection should be withdrawn.

The invention claims *summing the weights of all features* of the reference record that are *less than a predetermined difference* (between locations and orientations) when compared with the features of the test record *to determine a similarity score* that the test record matches the reference record.

Lin correlates test and reference fingerprints to determine a matching score, and then *combines matching scores from minutia* matching and ridge flow analysis.

The final matching score of fingerprint recognition is the combination of the scores from minutia matching and from ridge flow matching, which occurs in Step **207**. The com-

Applicant respectfully asserts that the combining of matching scores as described by Lin is not equivalent to the summing of weights that are less than a predetermined difference to determine a similarity score as claimed. Lin does not sum weights. Lin does not consider a difference between locations and orientations while summing.

Riganati cannot cure the defects of Lin. Each minutia is represented by its location and orientation, see column 2.

in a reference file. In a preferred embodiment, each minutia from each fingerprint is described by its relative position and orientation and is selectively encoded in a relative information vector (RIV) format. Each RIV is

In Riganati, the matching score is the number of minutia that match.

of the RIVs in each of the known fingerprints. In this comparison operation a match score is determined from the number of minutiae in one RIV that match minutiae in the other RIV being compared. The set of match

However, Riganati like Lin does not disclose summing weights that are less than a predetermined difference to determine a similarity score. As stated above, the claimed matching score is a conditional sum of weights, while the matching score in Riganati is the number of matching features.

With respect to claim 2, as stated above, the similarity scores in claim 2 are patentably distinct from the what is described in Lin. Furthermore, at column 2, Lin uses a "matching checkerboard," and not a weighted feature as claimed, see

for the relaxed rigid transform. A "matching checkboard" is created for recording the pairs. For example, the test image T has N minutia points and the reference image R has M points. The checkboard size will be N×M. For

Also, the Examiner is again mixing up the 8x8 bit blocks and the features, at column 1 the dynamic thresholding is with respect to pixel intensity values, and not a similarity score, see

2. Dynamic thresholding. In step **101**, For each 8 bit×8 bit block of image, an average intensity value is calculated by simple addition of the intensity values then divided by sixty four, the number of bits in an 8×8 bit block. If the intensity value of a pixel in this 8 bit×8 bit block is above the average calculated intensity value its binary value is assigned to zero. Otherwise, its binary value is assigned to

Dynamic thresholding to compute average pixel intensity values has nothing to do with the claimed selecting of a particular reference record if a similarity score is greater than a maximum threshold. With all due respect, the Examiner's statement that the claimed maximum threshold is equivalent to the dynamic pixel intensity thresholding at column 1 is erroneous.

The features extracted in claim 3 are location and orientation, while Lin extracts bit blocks and ridges at column 1.

The features aligned in claims 4-5 are unlike the ridges aligned in Lin.

Applicant cannot find an "approximate alignment" at column 3, see

If, after transformation, the point in the test image falls in close range of a point in the reference image and they are of the same type and orientation, it will generate a high matching score. Otherwise it creates a low or zero score. The covariance matrix of each gaussian weighting function may be different; for example, if a point in reference image is far away from the point that generates this set of transformation parameters, its gaussian kernel may be larger than the ones who are closer. To compensate the distortion effect, the shape of the gaussian function is changed to a non-unity covariance matrix.

4. Matching ridge flows: In Step **204**, the same set of transformation parameters from minutia matching is also applied to the ridge flow map. The correlation between reference fingerprint and the transformed test fingerprint is served as another matching score.

Applicant respectfully request which line refers to an "approximate alignment," in the section cited by the Examiner to reject claim 7.

In rejecting claim 8, the Examiner admits that "Lin does not disclose function [sic] of distances between features and the local neighborhood of features."
But anyway, that has nothing to do what is claimed. In claim 8, what matters is "**setting the weight** of each feature proportional **to a function of distances** between each feature and the local neighborhood of features."

Riganati at column 5 only talks speculatively about how due to skin stretchability only a small region of a fingerprints should be matched, and "due to the belief that a small region approach would be of **limited weight** if the global characteristics of the two fingerprints being matched were not considered." Applicant is not sure what these speculative beliefs that small regions should be of limited weight has to do with the claimed setting of weights as a function of distance. It is inappropriate to lift the word "weight" out of context and ascribe to it some meaning that is not in the reference.

Neither can the Applicant find anything to with distances at column 8,

Referring now to FIG. 5, a more detailed block diagram of a preferred embodiment of the fingerprint minutiae pattern matcher invention is illustrated. As shown in FIG. 5, this fingerprint matcher is basically comprised of a data converter 39, a match comparator 41 and a score processor 43. Basically, the data converter 39 sequentially transforms input minutiae data (in X, Y, θ format) from an unknown fingerprint A (FP-A) and a known or reference fingerprint B (FP-B) into the relative information vector (RIV) format. The match comparator 41 compares each RIV of the unknown or unidentified fingerprint A with each RIV of the known fingerprint B and generates a match score for each RIV pair comparison to indicate the closeness of match of that RIV pair. The score processor 43 analyzes the set of RIV match scores from a global viewpoint and develops a final score which quantitatively indicates the degree of similarity between the two fingerprints being

Applicants respectfully requests the Examiner to point out what line in this cited section sets feature weights as a function of distance of local neighborhoods of features.

The other section at column 18 cited by the Examiner makes even less sense. There, Riganati **eliminates** features as a function of distance, read

"The number of a center minutia's neighbors included in its RIV *can be limited* by either *a maximum radial distance* $\mathbf{R}_T$ or an upper bound N_{max}, whichever is more restrictive. For the sake of this discussion *a maximum radial distance* R_T has been selected in FIG. 8 *to limit the number of neighboring minutiae* associated with a center minutia.

Now, combining the teaching of Riganati with Lin correctly would do nothing but eliminate minutia based on distances. It would certainly never set weights as a function of distances.

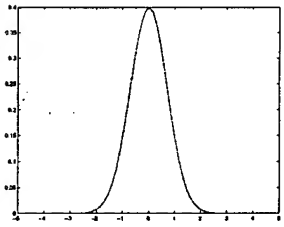
Examiner rejected claims 6, and 10-13 as being unpatentable over Lin et al., (U.S. 6,763,127 - 'Lin') in view of Riganati (U.S. 4,135,147 - 'Riganati'), and in Further view of Edgar (U.S. 6,487,321).

In claim 6, "a probability of matching features is represented by a zero-mean Gaussian function $f(0;\sigma^2)$."

Those of ordinary skill in the art know that a zero-mean Gaussian function is distinctly defined as

$$f(0;\sigma^2) = e^{(-x^2).(2\pi)^{-\frac{1}{2}}},$$

and is graphically represented as:



Applicant cannot find anything like this in **any** of the art cited by the Examiner.

The Examiner finds the words "probability," "zero," "mean," in the cited random sentences "A weight of *zero* may be assigned when the intensity value is below a certain low threshold indicating a high *probability* that a defect is present with little or no image detail remaining," "Any pixel outside the boundaries of the image is set to *zero* for purposes of these calculations," "If the results have opposite signs, then the pixel in question is set to zero. Besides allowing *variance* in the red leakage value, such a bounded subtraction may compensate for registration error between visible channels of the digital image and the defect channel as well as for blurring that may occur in the defect channel," and amazingly concocts the claimed zero-mean Gaussian function from these random words. These words can have only been found by some meaningless word search, and are taken totally out of context. With all due respect, the rejection of claim 6 is, to say the least, bizarre.

Similarly, the rejections of claims 10-13 are based on random words selected from Edgar, without any reasoning or connectivity with what is claimed. There is no distance function in terms of an arithmetic mean at column 6 in Edger, although the

words "mean average," "arithmetic average," "geometric average" do appear, but in a totally different context than what is claimed.

Claim 15 is new and combines the base claim, with allowable claim 14 and any intervening claims.

All rejections have been complied with, and applicant respectfully submits that the application is now in condition for allowance. The applicant urges the Examiner to contact the applicant's attorney at phone and address indicated below if assistance is required to move the present application to allowance. Please charge any shortages in fees in connection with this filing to Deposit Account 50-0749.

Respectfully submitted,
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